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Study on Comparative Analysis of Production of Dry Fruit Economic Forest Products Based on Big Data



Abstract: - The analysis of economic forest products production in Shandong Province mainly focuses on economic forest production and output value as well as economic forest plantation area, capital and labour input. By analysing the above, the basic situation of economic forest products production in Shandong Province can be understood on a macro level, laying the foundation for the subsequent study of the relevant data of the farmers, and at the same time providing a reference for the relevant management. There is an obvious gap between the production value of economic forest products in Shandong Province and that of the whole country. By combining modern information technologies such as 3S, Internet of Things, artificial intelligence, big data, cloud computing and other modern information technologies, we have established an integrated modern forest cultivation technology system ranging from the intelligent evaluation of forest terrain conditions, ecological environment simulation and simulation to the precise monitoring and diagnosis of forest growth, intelligent equipment and variable irrigation and fertilisation, etc. It is of great practical significance to expand the scale of production value of economic forest products in Shandong Province and narrow the gap with the national average level by carrying out research on the production and management efficiency of economic forest products in Shandong Province.

Keywords: Economic forest products, Analysis of variance, Intelligent forestry

I. INTRODUCTION

Information technology is an important driving force for the development of human civilisation and one of the fastest growing and most influential high technologies in the world today. With the wide application of modern information technology in the field of forestry, smart forestry has become a necessary road for the development of modern forestry. Forestry development is an important element of China's ecological and economic construction. Forestry is both a public welfare undertaking and a basic industry, with irreplaceable ecological benefits and considerable economic value. Shandong Province is a major forestry province in China, and the total output value of the forestry industry in Shandong Province ranked second in the country in 2017. Located in the lower reaches of the Yellow River in the eastern part of China's country, Shandong Province has a warm-temperate monsoon climate type, with natural geographic conditions suitable for the cultivation and growth of fruit trees, with more than 3,000 varieties and types of economic forests and more than 30 types of woody oilseeds with production value, and a fast development of the economic forest industry [1-3]. Dry fruit economic forest production has a pivotal role in the country, in which the production of farmers' economic forest products plays an important role.

II. INTELLIGENT FORESTRY

A. Connotation, Definition and Characteristics of Smart Forestry

Intelligent forestry is based on "digital forestry", i.e. the whole process of collecting, processing, storing, analysing, applying and sharing multi-scale spatial and attribute information of forests under the framework of "Digital Earth" proposed at the end of the 20th century by using computers, the Internet, virtual reality, and 3S (i.e. Remote Sensing (RS), Global Navigation Satellite System (GNSS), Geographic Information System (GIS)) technologies; the main features are digitisation, networking and visualisation. (In 2008, with the introduction of the concept of "Smart Earth", smart forestry as an important part of it also came into being. Intelligent forestry integrates key technologies in digital forestry with artificial intelligence, Internet of Things, big data, cloud computing, mobile Internet and other new generation of information technology and forestry intelligent equipment in an interdisciplinary and in-depth manner, and forms a new model of forestry information technology development for the whole process of forestry production and management (including intelligent breeding, cultivation, monitoring, management and protection, etc.) and the development and utilisation of forestry resources, such as three-dimensional sensing, accurate cultivation, real-time monitoring, intelligent management

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and intelligent decision-making, and so on. The new mode of forestry informatisation development will be formed. As shown in Figure 1 and Figure 2. [4-6]

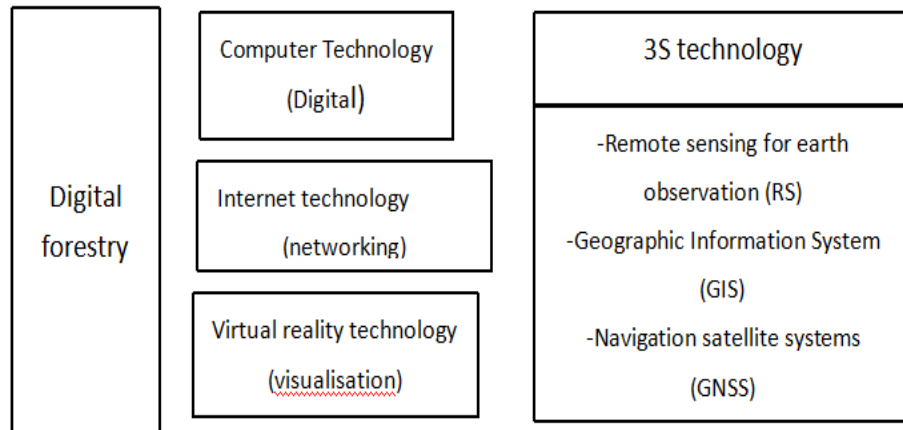


Figure 1: Intelligent Forestry (Forestry Informatisation 2.0: Perception, IOT, Intelligence)

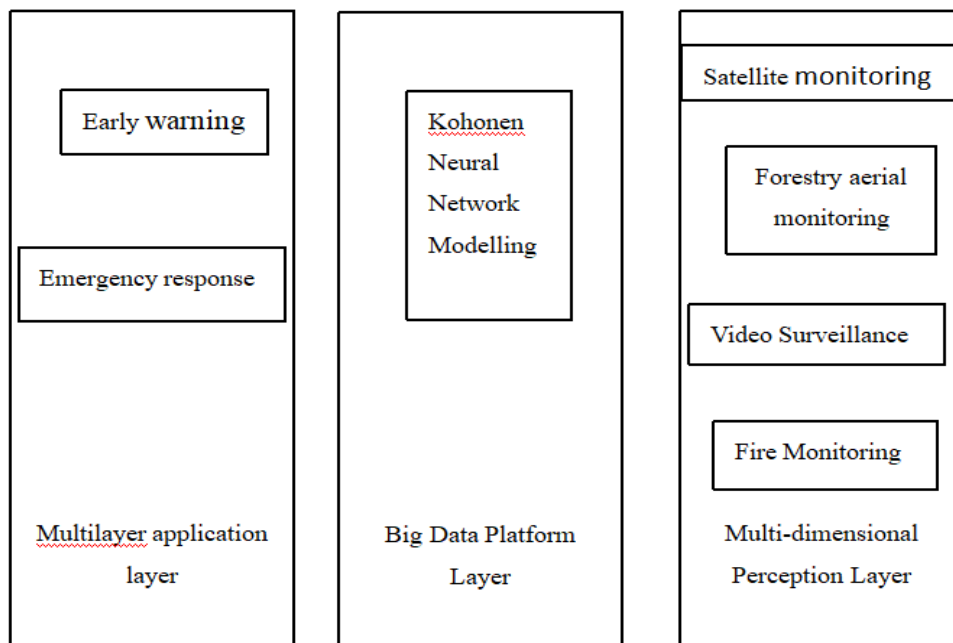


Figure 2: Intelligent Forestry (Forestry Informatisation 2.0: Perception, IOT, Intelligence)

B. Problems in the Protection of Forestry Ecological Resources

Forest-related cases are mainly classified as indiscriminate logging, illegal trading, illegal land occupation, illegal change of forest land use, unlicensed transport, and forest fires. From the figure, it can be seen that the number of forest-related cases in this area is relatively high, and the proportion of illegal logging cases in the forest-related cases is more than 80%, which seriously affects the normal development of local forestry ecological resources. The protection of forestry ecological resources is the core issue that needs to be optimised in the management of forest areas. China's forest ecological resources data are numerous, such data if you only use manual analysis mode, due to the variety of data types, data size is huge, there will be slow analysis speed, data analysis results have error problems. At present, in the forestry ecological resources protection, the use of big data technology is not mature, how to give full play to the application value of big data in forestry ecological resources protection is one of the problems of forestry ecological resources protection at present. As shown in Table 1 and figures 3. [7-9]

Table 1: Forestry Ecological Resources Protection System Based on Big Data

Type of case	Number/case
Indiscriminate logging	227
Illegal trading	14
Illegal land occupation	11
Illegal change of forest land use	9
Transport without licence	7
Forest fires	16
Total	284

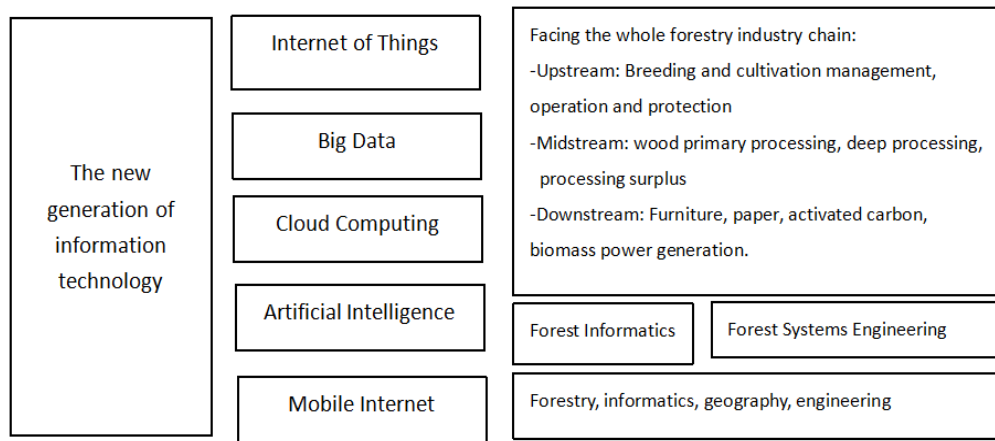


Figure 3: Details of Forest-related Cases in a Region

III.ANALYSIS OF THE BASIC SITUATION OF NATIONAL PRODUCTION OF ECONOMIC FOREST PRODUCTS

A. Trends in National Economic Forest Area Analyses

The country is rich in economic forest resources, with a total area of economic forests of more than 20 million hm^2 , accounting for 2.13 per cent of the total land area. There are more than 100 kinds of economic forests with high economic value that can be developed and utilised, of which the area and output of apples, pears, jujubes, chestnuts and ginkgoes rank first in the world, and the areas of economic forests in Shandong Province, Yunnan Province and Hunan Province are 1,969,000 hm^2 , 1,665,000 hm^2 and 1,582,000 hm^2 respectively. [10-12]

Figure 4 shows the changes in the area of economic forests nationwide. As can be seen from Figure1, the area planted with economic forests nationwide has continued to increase, and the area planted with economic forests has basically remained stable during the period from the Seventh Forest Resources Inventory to the Ninth Forest Resources Inventory. Specifically, the area planted with economic forests nationwide increased from 7,457,400 hm^2 during the first forest inventory from 1950 ~ 1962 to 21,390,000 hm^2 during the sixth forest inventory from 1999 ~ 2003, an increase of 1.87 times, and by the time of the ninth forest inventory, the area planted with economic forests nationwide was 20,927,900 hm^2 , which was slightly smaller than that during the sixth forest inventory (Figure 1 shows that the area planted with economic forests has basically remained stable during the period from the seventh forest inventory to the ninth forest inventory). The area of economic forest was slightly reduced (State Forestry and Grassland Administration, 2019). This is mainly due to the fact that since the founding of New China, the state has attached importance to ecological construction and encouraged afforestation, which has led to the development of economic forests [13-16]. In recent years, with the continuous expansion of economic forest plantation area, localities have gradually formed characteristic economic forest plantation, no longer blindly expanding the plantation area, but through the development of high-quality characteristic economic forest products to achieve precise poverty alleviation and drive the development of the regional economy, which has led to the steady development of economic forests, and the area has been slightly reduced. [17-20]

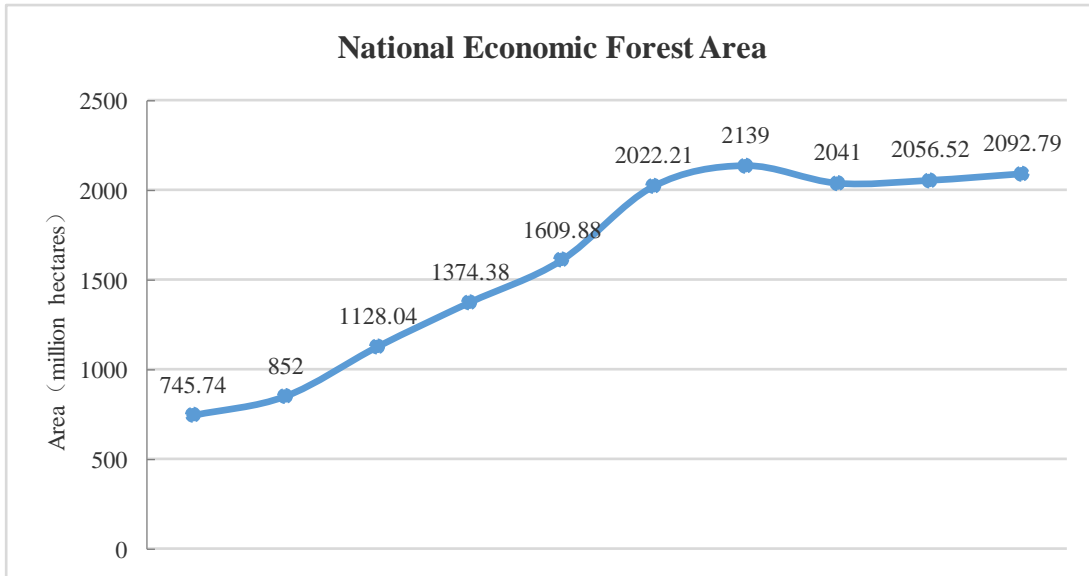


Figure 4: Changes of Economic Forest area in China
 Source of data: First - Ninth National Forest Inventory Data.

B. Changes in the Value of Economic Forest Production and Its Composition

The output value of national economic forest products is generally on an increasing trend. According to data from the China Forestry Statistical Yearbook, changes in the output value of different types of national economic forest products from 2000 to 2017 are shown in Table 2 and Figure 5. As can be seen from Figure 2:

Firstly, the overall national economic forest output value has shown a trend of rapid change. Specifically, the national economic forest production value was 30.69 billion yuan in 2007, and increased to 139.257 billion yuan in 2017, a 44.37-fold increase, growing at an average annual rate of 46.44 per cent. This shows that the national economic forest production has developed rapidly along with the implementation of the national ecological construction policy. [21]

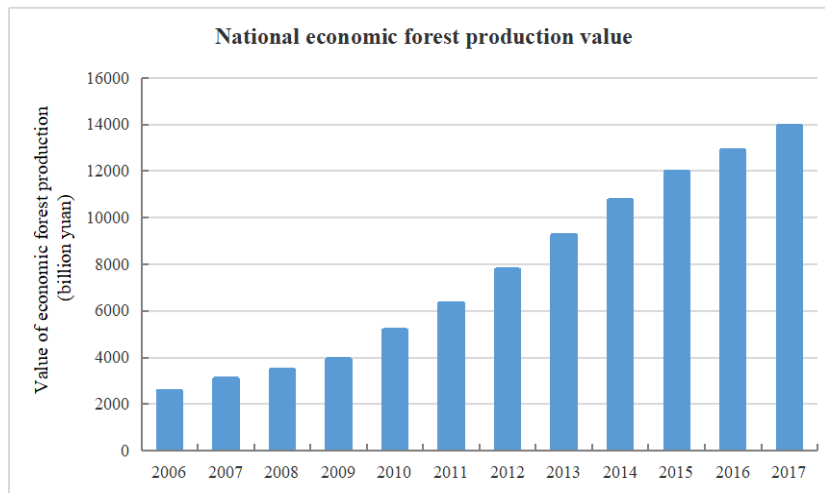


Figure 5: The change of Economic Forest output value in China
 Source of data: China Forestry Statistical Yearbook, 2006-2017.

Secondly, economic forest plantation products of nuts, oleaginous fruits and spice crops are an important part of the national economic forest, and an important driving force for the increase in the output value of the national economic forest. Specifically, in 2017, the output value of economic forest plantation products of nut, oleaginous fruit and spice crops was 226.174 billion yuan, accounting for 16.25% of the total output value of economic forests nationwide during the same period; at the same time, economic forest plantation products of nut, oleaginous fruit and spice crops also showed a trend of rapid development. In 2000, the output value of economic forest plantation products of nut, oleaginous fruit and spice crops was 99.5 billion yuan, and its output value increased to 226.174 billion yuan in 2017, an increase of 1.27 times, although this growth rate is slower than the overall growth rate of the national economic forest output value, but it also shows that the development of nuts,

oleaginous fruits and spice crops is one of the important driving forces to promote the increase of the national economic forest output value.

Thirdly, the planting and gathering of fruits and dried fruits is a major component of the nation's economic forests and has shown a trend of rapid development. Specifically, in 2017, the output value of planting and gathering of fruits and dried fruits nationwide was 693.4 billion yuan, far exceeding the output value of planting and gathering of tea and other beverages and planting of nuts, oleaginous fruits, and spice crops, and accounting for 49.8 per cent of the nation's output value of economic forest products in the same period. This shows that the output value of planting and collecting fruits and dried fruits constitutes the main body of the national economic forest industry output value. At the same time, the national output value of economic forest products in the planting and gathering of fruits and dried fruits category has shown a trend of rapid development, with the output value of economic forest products in the planting and gathering of fruits and dried fruits category having increased from only RMB 161.8 billion in 2006 to RMB 693.4 billion in 2017, a 3.29-fold increase, which indicates that the national output value of economic forest products in the planting and gathering of fruits and dried fruits category has shown a trend of rapid development.

Fourth, economic forest products of tea and other beverages cultivation and collection are also an important part of the national economic forest, and promoting the development of economic forest products of tea and other beverages cultivation and collection is an important measure to promote the development of economic forest products in the country. Specifically, in 2017, the output value of economic forest products of planting and gathering of tea and other beverages was 137.952 billion yuan, accounting for 9.9% of the total output value of economic forests nationwide in the same period; at the same time, economic forest products of planting and gathering of tea and other beverages have shown a trend of rapid development. The output value of economic forest products of planting and gathering of tea and other beverages was 23.6 billion yuan in 2006, and it was 23.6 billion yuan by 2017. In 2006, the output value of economic forest products grown and collected for tea and other beverages was 23.6 billion yuan, and by 2017 it had increased to 137.952 billion yuan, an increase of 4.83 times, which was significantly faster than the output value of economic forest products grown for nuts, oleaginous fruits and spice crops, and which shows that the development of economic forest products grown and collected for tea and other beverages is an important initiative to promote the development of economic forest products nationwide.

Statistics on the change of output value of different types of economic forest products in the country from 2000 to 2017 are shown in Table 2.

Table 2: Output value change of different types of Chinese economic forest products in 2000-2017 (ten thousand yuan)

vintages	Cultivation of nuts, oleaginous fruits and spice crops	Cultivation and collection of fruits and dried fruits	Cultivation and collection of tea and other beverages
2000	9951737	-	-
2001	10681911	-	-
2002	11341453	-	-
2003	12748153	-	-
2004	-	14321174	-
2005	15312069	-	-
2006	-	16182719	2368078
2007	-	20112371	2843519
2008	-	22908897	3239189
2009	-	25487275	3689609
2010	-	35101489	4266853
2011	-	41551549	5521051
2012	-	50442366	7185892
2013	14427279	46141257	8639600
2014	17415409	54929097	9961757
2015	20202817	59377741	10986200
2016	21868847	64531535	11770578
2017	22617489	69343392	13795239

Source of data: China Forestry Statistical Yearbook, 2000-2017.

C. Dry Fruit Economic Forest Production and Its Composition

Figure 6 shows the changes in the national output of economic forest products and dried fruit economic forest products from 2005 to 2017. As can be seen from Figure 3, the national output of economic forest products shows a trend of steady growth. Specifically, in 2005, the national output of all kinds of economic forest products was 92,287,200t, and it grew to 187,811,600t in 2017, with an increase of 95,524,400t, an increase of 1.035 times, which indicates that the national output of economic forest products has shown a trend of rapid development; at the same time, the national dry fruits category of economic forest products has also shown a trend of rapid development, in which the In 2005, the dry fruit economic forest products were 3,495,600t, and grew to 11,160,400t in 2017, with an increase of 7,664,800t, an increase of 2.19 times, which is twice as much as the growth of the national economic forest products output.[22]

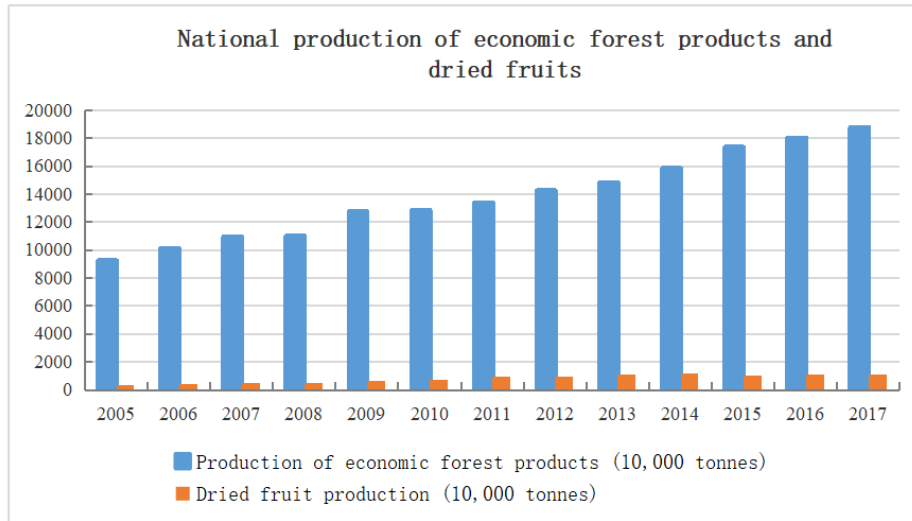


Figure 6: Changes in the output of Economic Forest products in China
Source of data: China Forestry Statistical Yearbook, 2005-2017.

Figure7 shows the changes in the national output of major dry fruit economic forest products from 2007 to 2016. As the statistics of walnut and ginkgo in the 2017 China Forestry Statistical Yearbook are incomplete, the data from 2007 to 2016 are selected for analysis and research in order to facilitate a unified comparative analysis. It can be seen from Figure 4: economic forest products such as walnuts, chestnuts, jujube and ginkgo all show a trend of rapid development, but the growth rate of economic forest products of different dry fruit categories is different. Specifically, in 2007, the output of walnuts, chestnuts, jujubes and ginkgo was 630,000t, 1,266,000t, 1,221,000t and 507,000t respectively, and by 2016, the output of walnuts, chestnuts, jujubes and ginkgo had increased to 3,645,000t, 2,289,000t, 6,249,000t and 1,448,000t, with an increase in production of 3.01milliont, 1,020,000t, 5,028,100t and 9,760,000t, an increase of 4.78 times, 0.81 times, 4.11 times and 1.92 times respectively, of which walnuts grew the fastest, jujubes the second, ginkgoes the third and chestnuts the slowest.

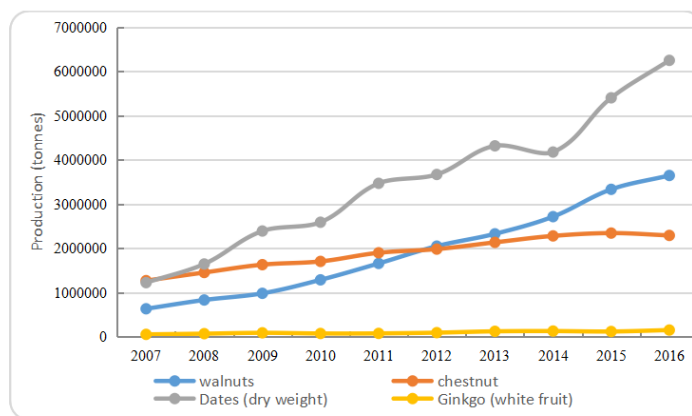


Figure 7: Changes of Output of Main dry Fruit Economic Forest Products
Data source: China Forestry Statistical Yearbook, 2007-2016.

D. Investment and Labour Input in the Production of Economic Forest Products

1) *Financial investment in the production of economic forest products:* Figure 8 shows the changes in the amount of investment in the national speciality economic forests, from which it can be seen that: the total amount of investment in the production of national economic forest products has been increasing; in 2011, the total amount of investment in the national economic forests was 4.01 billion yuan, and in 2017, it increased to 19.36 billion yuan, which is a 3.83-fold increase, with an average annual growth rate of 30.01 per cent. From the source of funds, self-financing has become the main source of funds for the development of the national economic forest industry. In 2016, for example, the total investment capital for the development of the national economic forest industry was 12.07 billion yuan, of which 251 million yuan, 1.10 billion yuan, 1.38 billion yuan, 45 million yuan, 8.03 billion yuan, 1.26 billion yuan, or 2%, 9%, 9% 11 per cent, 0.4 per cent, 67 per cent and 10 per cent, respectively; this shows that self-financing has become the main source of development of the national economic forest industry.[23]

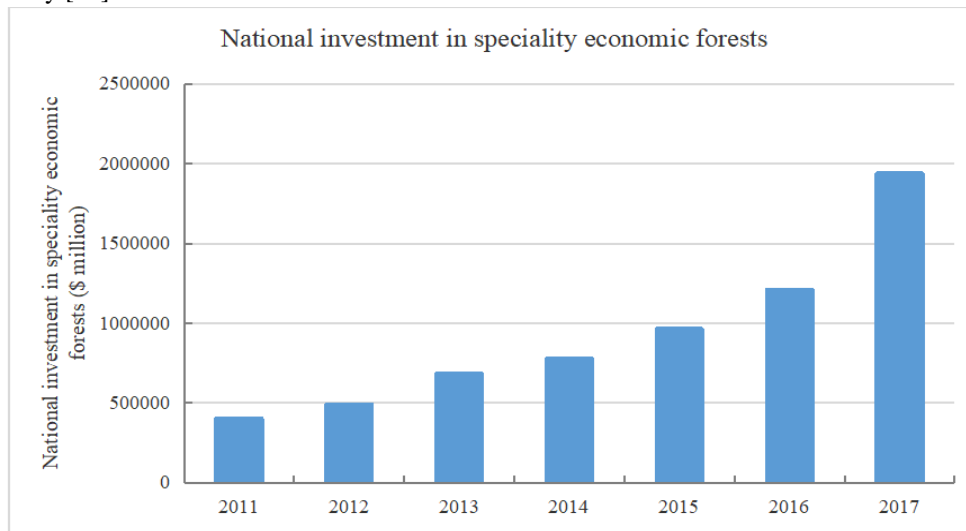


Figure 8: Changes in the Amount of Investment in Economic Forests with Special Characteristics in China
Source: China Forestry Statistical Yearbook, 2011-2017.

2) *Labour input in the production of economic forest products nationwide:* Table 3 shows the labour input for the production of economic forest products in the country. It can be seen from Table 3:

First, the labour input for economic forest development in the country has been decreasing in terms of different indicators. Specifically, the number of economic forest planting and collecting units nationwide has shown a decreasing trend, falling from 586 units in 2013 to 247 units in 2017, a decrease of 57.85%; the year-end number of labourers engaged in economic forest planting and collecting nationwide fell from 70.96 million in 2013 to 45.68 million in 2017, a decrease of 35.63%, which is a significant decline. The year-end number of employees in economic forest plantation and collection units decreased by 37.69%, also declining more significantly. At the same time, the number of economic forest planting and collecting on-the-job employees also had a similar pattern of change, indicating that the overall number of economic forest employees nationwide showed a downward trend of change.[24]

Table 3: The status of Labour input in the Development of Economic Forest Industry in China

vintages	Number of units (a)	Number of persons in units at the end of the year (10,000)	Number of employees at the end of the year (10,000)	Employed workers (10,000)	Total annual wages of employees on board (in thousands of yuan)	Average annual wage of employed workers (\$)
2013	586	7096	6993	6612	53375	26100
2014	413	5922	5773	5698	28486	/
2015	356	5546	5451	5239	/	38434
2016	286	5203	5015	4731	201293	41572
2017	247	4568	4357	4222	/	47217

Source: China Forestry Statistical Yearbook, 2013-2017.

Secondly, judging from the total wages of economic forestry employees, the wages of economic forestry planting and gathering employees nationwide show a constantly rising trend of change. In 2013, the total annual wages of on-the-job employees was 53.375 million yuan, and it increased to 2012.993 million yuan in 2016, an increase of 147.918 million yuan, or an increase of 2.77 times; judging from the average annual wages of on-the-job employees, in 2013, the average annual wage of on-the-job employees was 26,100 yuan, while it increased to 47,217 yuan in 2017, an increase of 21,117 yuan, or 80.9%, which indicates that the wages of economic forestry employees nationwide have shown an increasing trend. This is contrary to the trend of changes in the number of economic forestry employees in different regions, which indicates that compared with other industries, the wages of employees in the economic forestry industry are generally low, and after deducting the effects of inflation and price increases, the real wage changes are not significant, and the attraction for talents is limited.

IV. CONCLUSION

The forestry ecological resources protection system based on big data enables staff to use mobile phones to monitor forestry ecological resources in real time, greatly improving work efficiency; can use big data analysis to quickly and scientifically diagnose the state of forestry ecological resources, and realise intelligent management; and can also be used as an information interface through the big data technology, the geographic information system (GIS) applied to the construction of forest plans, and thus achieve rational planning. It can also be used as an information interface to apply geographic information system (GIS) in the construction of forest plan, thus realising rational planning of forestry ecological resources.

Accurate irrigation and fertilisation management of forest trees through information technology will effectively improve the efficiency of water and fertiliser use, save economic costs such as labour and water and fertiliser, and reduce environmental pollution caused by improper fertiliser application. In this paper, the issue of economic forest product production in the whole country and Shandong Province was statistically analysed mainly from the macro level. Firstly, the basic situation of the national economic forest products production is introduced, specifically, the national economic forest plantation area, production, output value and its structure are analysed, and the development environment situation of the economic forest industry development such as capital input, labour input is analysed; secondly, the basic situation of the economic forest products production in Shandong Province is analysed, and similarly, the economic forest plantation area in Shandong Province is also analysed, production, output value and its structure were analysed, as well as the basic situation of production such as capital input and labour input for the development of economic forest industry in Shandong Province. On this basis a comparative study was also made between the economic forests of Shandong Province and the relevant development situation of the national production of economic forest products. The study found:

(1) The economic forest plantation area, the output of all kinds of economic forest products and their output value in Shandong Province have shown a rising trend, which is related to the increasing investment in the production of economic forest products with special characteristics in Shandong Province, but the number of labour inputs in the production of economic forests in Shandong Province has been declining.

(2) The wages of economic forestry employees across the country and the wages of economic forestry product production employees in Shandong Province have shown an increasing trend, which is a side effect of the fact that the labour cost of economic forestry product production and operation is increasing across the country.

(3) The output and value of dry fruit economic forest products such as chestnuts, walnuts, jujubes and ginkgoes in Shandong Province have shown an increasing trend, and have become an important part of the national production of chestnuts, walnuts, jujubes and ginkgoes.

(4) Comparison of ANOVA and Gini coefficient analyses show that there are obvious differences between the national economic forest product production and that of Shandong Province in terms of per capita output value, per capita product output and economic forest production efficiency, and that it is meaningful to carry out a study on the production efficiency of economic forest products by farmers in Shandong Province. Accurate irrigation and fertilisation management of forest trees through information technology will effectively improve the efficiency of water and fertiliser use, save economic costs such as labour, water and fertiliser, and reduce environmental pollution caused by improper fertiliser application.

ACKNOWLEDGMENT

The study is sponsored by the project (No.121102000000190014; No.2017LD03; No.121102000000190009).

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